

UNIVERSITI SAINS MALAYSIA

First Semester Examination
2016/2017 Academic Session

December 2016 / January 2017

EPE 441 – Micro And Nano Manufacturing Engineering *[Kejuruteraan Pembuatan Mikro Dan Nano]*

Duration : 2 hours
[Masa : 2 jam]

Please check that this paper consists of SEVEN printed pages, and FOUR questions before you begin the examination.

Sila pastikan bahawa kertas soalan ini mengandungi TUJUH mukasurat, dan EMPAT soalan yang bercetak sebelum anda memulakan peperiksaan.

Instructions : Answer **ALL** (4) questions.
*[Arahan : Jawab **SEMUA** (4) soalan.]*

In the event of any discrepancies, the English version shall be used.

[Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah diguna pakai.]

Write your index number in the space provided on the question paper to be attached to answer sheet.

[Tulis nombor angka giliran dalam ruangan yang disediakan pada kertas soalan peperiksaan untuk dikepilkan bersama kertas jawapan.]

- Q1. [a] Choose ONE(1) nano-scale product and describe the interrelation of roles between nano-sciences, engineering and technology in developing the product.**

Pilih SATU(1) produk skala nano dan huraikan hubungkait peranan antara nano-sains, kejuruteraan dan teknologi dalam membangunkan produk tersebut.

(30 marks/markah)

- [b] Say, current hazy season has caused you coughing, runny nose and dizzy. You went to see a doctor and he prescribed you an antibiotic. What would be your response to that prescription and justify your response?**

Katakanlah, musim jerebu sekarang telah menyebabkan anda batuk, hidung berair dan pening. Anda pergi untuk berjumpa doktor dan beliau memberi preskripsi antibiotik kepada anda. Apakah respon anda kepada preskripsi itu dan kewajaran respon anda?

(40 marks/markah)

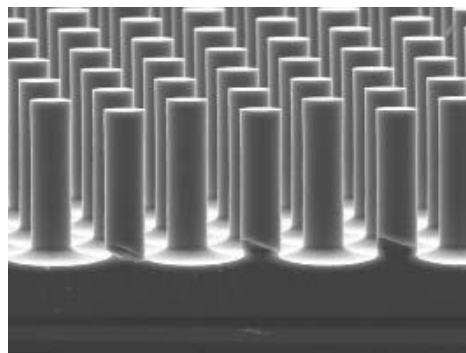
- [c] Suggest ONE(1) product which functioning using piezoelectric, pyroelectric or ferroelectric material. Describe how the product works.**

Cadangkan SATU(1) produk yang berfungsi menggunakan bahan piezoelektrik, piroelektrik atau feroelektrik. Terangkan bagaimana produk itu berfungsi.

(30 marks/markah)

- Q2. [a] Figure Q2[a] shows a SEM image of side view of MEMS resonator fabricated on a silicon substrate. Design a complete process flow for fabricating these micro-pillars structures. Provide as much process details as possible.**

Gambarajah S2 [a] menunjukkan imej SEM pandangan sisi sebuah resonator MEMS yang difabrikasi di atas substrat silikon. Sila reka-bentuk aliran proses yang lengkap untuk membina struktur mikro-tiang ini. Berikan sebanyak mungkin butiran prosesnya.



https://nowsimplified.files.wordpress.com/2014/08/memspillars_opt.jpeg

Figure Q2[a]

Gambarajah S2[a]

(70marks/markah)

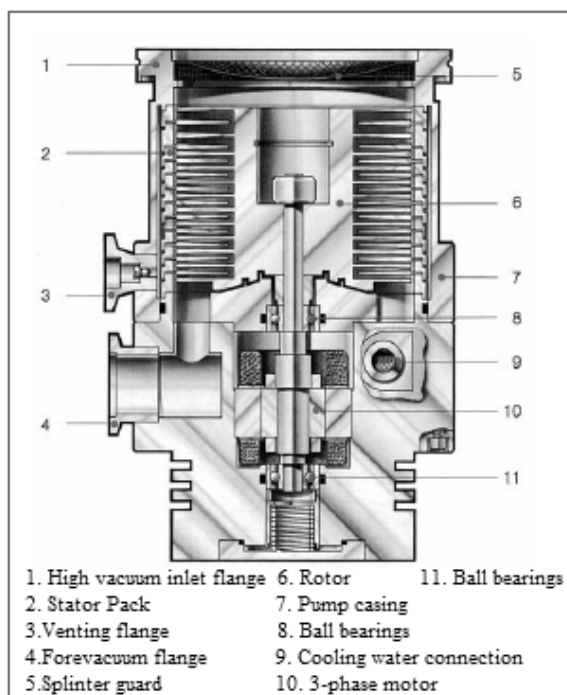
- [b] **Differentiate between Etching Directionality and Etching Selectivity. Provide necessary diagrams.**

Terangkan perbezaan antara Punaran Berhaluan arah dan Punaran Pilihan. Sokong keterangan dengan gambarajah yang perlu

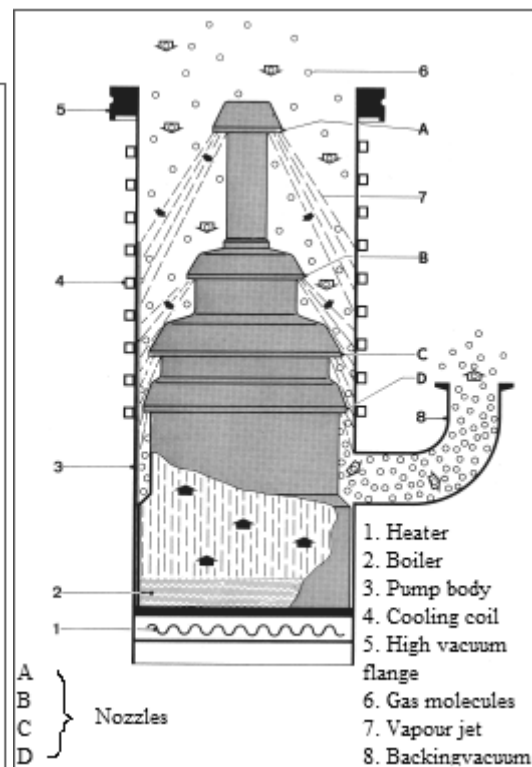
(30marks/markah)

- Q3. [a] Figure Q3[a] (X) and (Y) show the schematics of two vacuum pumps. Determine the type of these vacuum pumps. Discuss about the working principles, and their advantages and disadvantages.**

Gambarajah S3 [a] (X) dan (Y) menunjukkan skematik pam vakum. Tentukan jenis pam vakum ini. Bincangkan tentang prinsip-prinsip kerja, dan kelebihan dan kekurangan mereka.



(X).



(Y).

Figure Q3[a]
Gambarajah S3[a]

(30marks/markah)

- [b] Figure Q3[b] shows radiolarian (protozoa) images under [a] optical/light microscope and [b] scanning electron microscope (SEM)**

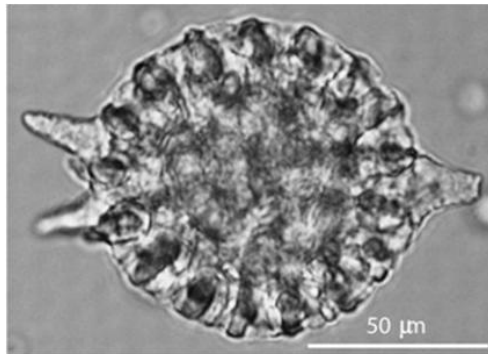
Gambarajah S3 menunjukkan imej radiolaria (protozoa) di bawah [a] mikroskop optik / cahaya dan [b] mikroskop imbasan elektron (SEM)

- (i) Describe the differences between Optical Microscopy and Scanning Electron Microscopy (SEM).**

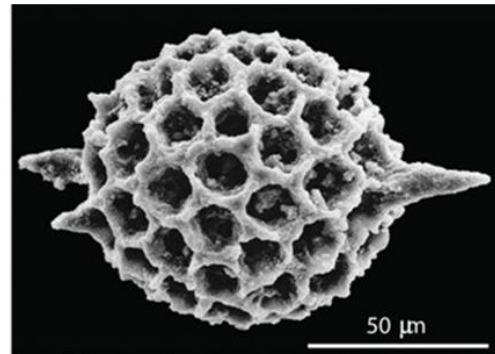
Terangkan perbezaan antara Mikroskopi optik dan Mikroskopi Imbasan Elektron (SEM).

- (ii) Give THREE (3) optical imperfection of Optical Microscope that caused blurred image.**

Berikan TIGA (3) ketidaksempurnaan optik bagi mikroskop optik yang menyebabkan imej kabur.



(a) Radiolarian under light microscope



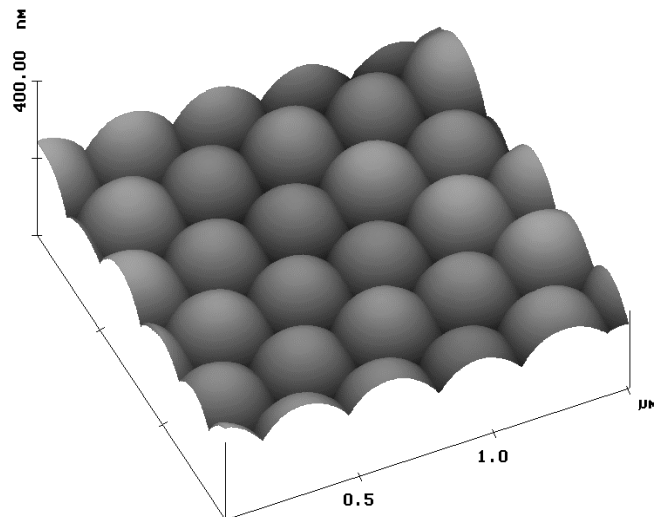
(b) Radiolarian under electron microscope

Figure Q3[b]
Gambarajah S3[b]

(40marks/markah)

- [c] **Figure Q3[c] shows three-dimensional (3D) atomic force microscope (AFM) image of natural sedimentation of silica spheres. Briefly describe on how the AFM system works in achieving high resolution of atomic scale topography.**

Gambarajah S3[c] menunjukkan imej tiga dimensi (3D) oleh mikroskop daya atomik (AFM) keatas suatu mendapan semula jadi sfera silika. Terangkan secara ringkas bagaimana sistem AFM berfungsi dalam mencapai resolusi tinggi untuk topografi skala atom.



<http://www.icmm.csic.es/cefe/Imagenes/AFM.gif>

Figure Q3[c]
Gambarajah S3[c]

(30marks/markah)

- Q4. [a] CNN 28 September 2016 - A three-parent baby was born in Mexico, on April 6, 2016 that conceived using a controversial method. The process involves adding a handful of genes from a donor woman to the mother's egg and then fertilizing the egg with the father's sperm to create an embryo, which becomes a baby. A team of doctors, led by Dr. John Zhang, founder of the New Hope Fertility Center in New York City, went to Mexico to perform the procedure. The Food and Drug Administration has not approved the technique, while Mexico is free of such regulations.**

(Source:- <http://edition.cnn.com/2016/09/27/health/3-parent-baby/>)

This conceiving method of three-parent using technique called “spindle nuclear transfer” instead of traditional two-parent has invited controversy on cloning regulation using mutation. Compose your thought on the ethical issues and values in cloning practice.

CNN 28 September 2016 - Seorang bayi tiga-ibubapa dilahirkan di Mexico, pada 6 April 2016 yang dihamilkan dengan menggunakan kaedah yang kontroversi. Proses ini melibatkan menambah beberapa gen daripada seorang wanita penderma telur ibu dan kemudian membaja telur dengan sperma bapa untuk mewujudkan embrio, yang menjadi bayi. Sekumpulan doktor yang diketuai oleh Dr John Zhang, pengasas Fertility Center New Hope di New York City, pergi ke Mexico untuk melaksanakan prosedur. Pentadbiran Makanan dan Dadah (FDA) masih tidak meluluskan teknik ini, manakala Mexico tiada apa-apa peraturan tentang perkara ini.

Sumber: - <http://edition.cnn.com/2016/09/27/health/3-parent-baby/>
 Kaedah hamil tiga-ibubapa yang dipanggil “pemindahan nuklear spindle” dan bukannya tradisi normal dua-ibubapa telah menjemput kontroversi pada peraturan pengklonan secara mutasi. Karang pemikiran anda mengenai isu-isu etika dan nilai dalam amalan pengklonan.

(50 marks/markah)

- [b] **“Advances in roll-to-roll processing of graphene and carbon nanotubes have at last led to the continuous production of high-quality coatings and filaments, ushering in a wave of applications for flexible and wearable electronics, woven fabrics, and wires. These applications often require specific electrical properties, and hence precise control over material micro- and nanostructure. While such control can be achieved, in principle, by closed-loop processing methods, there are relatively few noncontact and nondestructive options for quantifying the electrical properties of materials on a moving web at the speed required in modern nanomanufacturing. Here, we demonstrate a noncontact microwave method for measuring the dielectric constant and conductivity (or geometry for samples of known dielectric properties) of materials in a millisecond. Such measurement times are compatible with current and future industrial needs, enabling real-time materials characterization and in-line control of processing variables without disrupting production.”**

(Source:- N.D. Orloff et al., “Noncontact conductivity and dielectric measurement for high throughput roll-to-roll nanomanufacturing”, *Scientific Reports*, 5:17019, 2016)

Based on the statement above, please elaborate more on the roles and the importance of Nanomanufacturing researches especially roll-to-roll nanomanufacturing for future economy.

"Kemajuan dalam pemprosesan graphene dan karbon nanotube menggunakan kaedah gelung-ke-gelung telah akhirnya membawa kepada pengeluaran berterusan bagi lapisan berkualiti tinggi dan filamen, bermulanya gelombang penggunaan elektronik fleksibel dan boleh pakai, kain tenunan, dan wayar. Aplikasi ini sering memerlukan sifat-sifat elektrik tertentu, dan kawalan itu lebih tepat untuk bahan mikro dan struktur nano. Walaupun kawalan itu boleh dicapai, pada dasarnya, dengan kaedah pemprosesan gelung tertutup, terdapat beberapa pilihan tanpa-sentuh dan tanpa-musnah untuk mengukur sifat-sifat elektrik bahan-bahan di web yang bergerak pada kelajuan yang diperlukan dalam pembuatan nano moden. Di sini, kita menunjukkan kaedah gelombang mikro tanpa-sentuh untuk mengukur pemalar dielektrik dan

kekonduksian (atau geometri bagi sampel sifat dielektrik diketahui) bahan-bahan dalam milisaat. Bilangan pengukuran itu selari dengan keperluan industri semasa dan masa depan, membolehkan pencirian bahan-bahan secara masa-nyata dan kawalan pembolehubah pemprosesan dalam talian tanpa mengganggu pengeluaran. "

(Sumber:- N.D. Orloff et al, "Kekonduksian tanpa-sentuh dan pengukuran dielektrik untuk pengeluaran tinggi bagi pembuatan nano gelung-ke-gelung", Scientific Reports, 5:. 17019, 2016)

Berdasarkan kenyataan di atas, sila terangkan dengan lebih jelas mengenai peranan dan kepentingan penyelidikan pembuatan nano terutamanya pembuatan nano gelung-ke-gelung demi ekonomi masa depan.

(50 marks/markah)

-oooOOOooo-